



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/672,029

09/25/2003

Thomas S. Dory

42P16663

7708

8791

7590

05/30/2007

BLAKELY SOKOLOFF TAYLOR & ZAFMAN

12400 WILSHIRE BOULEVARD

SEVENTH FLOOR

LOS ANGELES, CA 90025-1030

EXAMINER

VAN, LUAN V

ART UNIT

PAPER NUMBER

1753

MAIL DATE

DELIVERY MODE

05/30/2007

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

## Office Action Summary

Application No.

10/672,029

Applicant(s)

DORY ET AL.

Examiner

Luan V. Van

Art Unit

1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 06 December 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-15 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-15 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |                                                                                                            |                                                                                         |
|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____                                                |

## **DETAILED ACTION**

### ***Response to Amendment***

Applicant's amendment of December 6, 2006 does not render the application allowable.

### ***Status of Objections and Rejections***

All rejections from the previous office action are withdrawn in view of Applicant's amendment.

New grounds of rejection under 35 U.S.C. 103(a) are necessitated by the amendments.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1-15 are rejected under 35 U.S.C. 103(a) as obvious over Palmans et al. (US patent 6398855) in view of Achuthan et al. (US patent 6472310).

Regarding claims 1 and 9, Palmans et al. teach a method of forming a microelectronic structure forming a recess in a substrate (figure 7-8); forming a metal layer (i.e., Ti/TiN layer by physical vapor deposition or atomic layer CVD, column 7 lines 53-56) within the recess; activating (column 6 lines 58-67) the barrier layer within the recess; electrolessly depositing a seed layer (column 7 lines 8-24) within the recess; and forming a metal fill layer over the seed layer (column 8 lines 12-46).

Since the metal layer Ti barrier layer of Palmans et al. is deposited by the same method (i.e., physical vapor deposition or atomic layer deposition, see column 7 lines 53-56) as that of the instant invention and to a thickness range of 15 nm, or 150 Angstrom, (column 8 lines 20-24), in features having the aspect ratios of 2:1 or higher (column 9 lines 5-10), it would have been obvious to one having ordinary skill in the art to expect that the Ti layer of Palmans et al. is non-continuous. Furthermore, since the palladium activator solution and subsequent electroless plating solution is applied on the surface of the metal layer, it would have been obvious to one having ordinary skill in the art to expect that the activator solution and electroless plating solution is activating or depositing on the metal layer and on at least the non-deposited region within the recess.

Palmans et al. differ from the instant claims in that the reference does not explicitly teach the specific thickness of the activating layer of the instant claims.

Achuthan et al. teach that the thickness of the activation layer are desired to be minimized to in turn minimize the volume of the activation layer within the interconnect opening. Minimizing the activation layer in turn maximizes the volume of the copper conductive fill material. Thus, maximizing the volume of the copper conductive fill material and minimizing the volume of the activation layer advantageously results in minimizing the resistance of the interconnect structure (see column 2 lines 51-67). In addition, Achuthan et al. teach that to prevent agglomeration of the activation layer, the thickness of the activation layer is scaled down to tens of angstroms (column 4 lines 27-31).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Palmans et al. by using the activation layer thickness of Achuthan et al., because it would prevent agglomeration of the activation layer, thus eliminating voids for minimizing electromigration failure of the copper interconnect (column 3 lines 37-41 of Achuthan et al.).

Regarding claim 2 and 10, Palmans et al. teach forming a high aspect recess comprising an aspect ratio up to 3.5 (column 8 lines 37-46), which is within the range of the instant claim.

Regarding claim 3 and 11, Palmans et al. teach forming a non-continuous comprising of Ti/TiN (column 6 lines 49-51).

Regarding claim 12, Palmans et al. teach electrolessly depositing a copper layer comprising a grain size of about 1  $\mu\text{m}$  or greater, since the copper layer of Palmans et al. is deposited by the same method and conditions as those of the instant claim.

Art Unit: 1753

Regarding claim 4-5, Palmans et al. teach depositing an activation layer wherein the activating layer within the recess comprises of palladium (column 6 lines 58-67) is formed on the non-continuous metal layer and the at least one non-deposited region within the recess.

Regarding claims 6, 13 and 15, Palmans et al. teach electroplating a copper layer on the seed layer (column 8 lines 35-46).

Regarding claim 7, Palmans et al. teach utilizing a chemical mechanical polishing process (column 8 lines 27-31).

Regarding claim 8 and 14, Palmans et al. teach forming a substantially void free metal fill layer, since Palmans et al. use the same plating method as that of the instant claims.

### ***Response to Arguments***

Applicants' arguments have been considered but are moot in view of the new ground(s) of rejection.

### ***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Luan V. Van whose telephone number is 571-272-8521. The examiner can normally be reached on M-F 9:30-6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

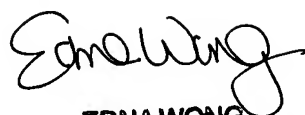
Application/Control Number: 10/672,029

Page 7

Art Unit: 1753

LWV

May 24, 2007

A handwritten signature in black ink, appearing to read "Edna Wong", with a stylized, flowing script.

EDNA WONG  
PRIMARY EXAMINER

5/25/07